STAGE 1 CONTRACT REPORT

Contract Reports. Methods for determining the benefits of safety audit. A scoping study
Final reports: 19 June 1997

CONTRACT 95/12 BENEFITS OF SAFETY AUDIT

STAGE 1 REPORT

rpt417

The results of the round table

The items recorded at the round table meeting on 22/2/96 were loosely categorised as physical (numerically measurable) and attitudinal. The resultant list was sent to all participants as a record of what was discussed and recorded. No other logical or editorial approach was applied (other than the separation just described, and the collation of a list of measures). Two suggested additions were received, and I have added a few more which appear to have been omitted.

Refinement of benefits

A spreadsheet of benefits was prepared, including benefits extra to the four prime objectives given in the Transit New Zealand guidelines which are:

> ***"minimise the risk and severity of accidents that may be created by the road project at the site and on the adjacent network:***
>
> ***minimise the need for remedial works after construction;***
>
> ***reduce the whole life costs of the scheme; and***
>
> ***improve the awareness of safe design practices."***

From the topics suggested at the round table, a short list of additional major topics of potential benefits was prepared, the balance being sub-sets of the new total list.

Additional possible benefits include:

> ***"improve the awareness of safe design practices (including in other professions),***
>
> ***increased skills in road safety engineering;***
>
> ***better management of schemes (from design to on going operation);***
>
> ***contributes to achieving road safety goals;***
>
> ***contributes to improved standards***
>
> ***better facilities for vulnerable road users;***
>
> ***contributes to more efficient use of funds;***

improves the knowledge and data base for road safety; and

better (designer and community) attitudes to road safety

A table was prepared with the above extended list as headings and other related "benefits" listed under the appropriate heading. This is table 4.

Methods of Measurement

The round table also listed a number of methods of measurement, also difficulties and needs in attempting to measure the benefits listed.

A difficulty became apparent immediately, because the efficiency of the process of safety audit - surely a desirable goal - did not appear as a benefit. This is so because there is no way of guaranteeing that the inclusion or omission of any topic or "problem" had a significant effect on the safety aspects of the scheme. It is theoretically possible for a safety audit team to omit a "problem" which, had it been included, could have made the scheme less safe.

However, it seems a reasonable assumption that given the prime aim of reducing the number and severity of injury accidents (known hereafter as crashes), it is a reasonable assumption that the efficiency of the following sequence of events has a bearing on the achievement of the goal of reduced crashes:

Identification of problem >
Information given to designer >
acceptance by designer >
correction of plans >
Correct building of the changed feature.

Diagram 1

It was therefore decided to persist with the list of benefits and treat the above as a separate issue to be evaluated.

A further table (5) was prepared listing potential methods of measurement on the left, with the same list of benefits on the x axis as were listed in table 1. It was hoped by this to determine the most useful and important combinations of benefit and method of measurement. Two degrees of shading were used to denote a strong link or a lesser one.

Yet another problem became apparent, because there is a need to define at the outset whether all benefits are sub-sets of the main aim of reducing crashes. If they are, then logically column 1 (number and severity) gets shaded for all methods of measurement. It seems hard to satisfy any sub topic without at the same time (or in the future) helping the main aim of crash reduction.

It was decided to assume that the other topics were capable of standing on their own and needed addressing separately otherwise the study became too focussed, and useful relationships possibly omitted or dealt with superficially. In effect, the first column does get shaded for all methods, while the sub-topics are identified for greater attention.

→ It is worth noting that the balance of the objectives in the guidelines (avoiding the need for remedial work, reduced whole life costs, and greater awareness), are themselves sub-topics of reducing crashes, though possibly the three most important.

Numerically measurable or not

In the minutes of the round table topics were separated into two categories: topics which were capable of direct measurement and those which were not. Some topics had aspects of both. Numbers and severities of crashes, costs of implementing measures resulting from safety audits, and acceptances/omissions are numerically measurable. Attitudes and opinions about topics are not directly numerically measurable though an attitudinal survey may come up with a rating, say, on a scale of 1 -5. Changes to standards or additional facilities for vulnerable road users may also yield a yes (included) or "no" - either omitted or not needed.

Matrix relating methods of measurement to objectives

Table 5 is an attempt to relate the applicability of methods of measurement to objectives. Two degrees of shading were used to represent perceived strong or weaker linkages. The prime goal of reducing crashes is the ultimate and prime goal of safety audit and whilst all measurement methods are seen as being supportive, some seem more directly connected and are recorded as such - with darker shading

No very clear picture emerged except that the following were all well represented in linkages to methods and all had strong linkages:

- ***improved awareness of design practices,***
- ***increased skills,***
- ***contributes to more efficient use of funds and***
- ***improved knowledge and data base***

While it may be possible to get a numerical value for the more efficient use of funds, the other three are all in the realm of opinion (unless some kind of examination of designers practices and skills!). There is at present a record of all crashes from non-injury to fatal for all New Zealand (with the LTSA), but no data base of items suggested by safety audit, acted upon and assessed. The introduction of such a system seems to offer good returns over an extended period.

Three kinds of topic

It seems logical to separate out the topics relating to the benefits and effectiveness of safety audit into three categories:

(1) Those relating to the process itself

(2) Those which are capable of producing direct, numerical statistical results by direct measurement, and

(3) Those which are the subject of opinion or answering questionaries.

For the purpose of this report, a list will be proposed for each of the above with a brief indication of the methodology available. Some topics will be capable of more than one approach and may therefore appear under two or more headings.

Table 1 -Topics relating to the process itself

(Diagram 1 on page 2 refers to the process)

TOPIC	METHOD 1	METHOD 2
Improved knowledge and data base for road safety	Collect all statistical information related to safety audits at central point and disseminate results.	Interview a sample of safety auditors (probably as part of a more general survey)
Identification of problems	Review a sample of audits to assess whether all possible problems had been identified	Arrange for more than one team to do the same scheme audit
Information given to designer	(Deal with as part of next topic - on the face of it not likely to be a major problem)	
Acceptance by designer	Follow up a selection of safety audits and determine which points accepted and which not, and why	
Correction or alteration of design plans	As part of the task above, ask designers to show or list changes.	
Correct building of the feature listed originally as a problem	Discuss this point with the client (ie justly Transit New Zealand or a district council)	Visit the site and see (a) how the problem had been dealt with (b) its performance in practice.

Table 2 -Topics capable of numeric or factual survey

In this category, hard answers are capable of being obtained. This will include statistics about changes to any assessable variable, and simple yes/no answers.

TOPIC	METHOD 1	METHOD 2
Minimise the risk or severity of crashes at the site or adjacent network.	Examine crash records for occurrence of types of crash which the audit has proposed counter measures. Determine if there are significant crashes of a type not foreseen Look for clustering or local prominences of crashes (one or more types)	Compare to similar networks in an attempt to derive typical crash rates and compare with the audited area. If methods 1 or 2 give positive leads, visit the site and try to assess why
Minimise the need for remedial works after construction.	Take a sample (possibly all) of sites audited and gather information from road controlling authority as to remedial works. Include quite minor matters like pavement marking and reflective signs.	It will be difficult but possibly worthwhile to compare with existing or unaudited sites using similar methods.
Reduce the whole life cost of the project	Similar to above (There appears to be no way other than some kind of predictive method not yet devised, of obtaining the whole life costs of any scheme)	Similar to the above
Better management of schemes	It may be possible to get design and management costs of schemes audited and not audited. It may be necessary to set up a special costing system of dubious worth.	
Contributes to achieving road safety goals	Monitoring of crash statistics, or improved attitude (see next section)	
Contributes to improved standards	List the changes. a "yes/no" situation	(Discuss with the guardians of standards.)
Better facilities for vulnerable road users	List the changes. a "yes/no" situation	(Discuss with the appropriate organisations)
Contributes to more efficient use of funds	Look at B/Cs of constructed, changed due to safety audit, and not audited and develop a model which will demonstrate or refute the hypothesis	

Table 3 -Topics which appear to be matters of opinion or attitude.

The following topics appear to be difficult or impossible to measure by direct statistical methods. It may, however, be possible to rank the knowledge, attitude or whatever on a scale of, say, 1 to 5.

TOPIC	METHOD 1	METHOD 2
Improve the awareness of safe design practices (including other professions)	Draw up a questionnaire to seek information, as well as noting eg: "Yes, improved"	Possibly check a series of designs to observe changed or improved practices (this will need a base to start from, and is really part of the previous group)
Increased skills in design and road safety engineering	As above. A similar topic and therefore done at the same time. Other support groups (eg civil engineering design of roads and bridges) should be included.	Talking to supervisors or peer group may help
Improves knowledge and data base for road safety.	As above. It will be necessary to talk to the guardians of data bases	
Better designer attitudes to road safety	As above. Devise some method of assessing attitude.	
Better community attitudes to road safety.	Difficult. The public will be unaware of safety audit, though the results may be apparent. safety audit of existing networks might raise the profile, at least with politicians.	Probably the best that can be achieved at this stage is to sample members of the public to determine their general attitude to road safety (and compare to their actions?) a different topic

Tables 4 and 5 (over)

An attempt has been made firstly to list all topics and sub topics which have arisen following the round table discussion.

In table 5, the 'benefits' on the top line of the table, are compared with potential methods of measurement.

Shaded areas at the intersection of a topic and a method indicate that the combination of topic and method is applicable. Very strong relationships, or those which appear to justify further study are shaded recognised by a darker shade.

Major topic >	Minimise the risk and severity of accidents at site or adjacent network	Minimise the need for remedial works after construction	Reduce the whole life costs of the project	Improve the awareness of safe design practices (including other professions!)	Increased skills in design and roadsafety engineering	Better management of schemes (design to operation)	Contributes to achieving road safety goals	Contributes to improved standards	Better facilities for vulnerable road users	Contributes to more efficient use of funds	Improves knowledge and data base for road safety	Better (designer) attitudes to road safety
Minor or related topics V	Safer networks in total	Saving remedial work		Clarifies issues, restrants on design, trade-offs	Leads to better understanding of road safety engineering	a. Management of mintenance		Alerts guardians of standards of situations where no guidance exists		Reduction of B/.C by identified(new) problems means potentially "dangerous" schemes not built	Contributes to monitoring road safety engineering	Gives support to designers, project managers and roading administrators (against local pressures- (& political MLG)
				May encourage more than one design (Thereby allowing other safer alternatives to be examined)	Helps designers to make better, safer designs	b. Reduced design costs (early audit can reduce design costs)		Alerts guardians of standards and guidelines of situations where there is no guidance		- therefore resources go to "better" projects- therefore greater accident savings	Better documentation of road safety engineering	Politicians awareness
				Independence of auditor assures "fresh eyes"	Educates traffic engineers, politicians, community			feedback, possibility of changing standards and how they are applied			Promotes recording roading improvements	Educates traffic engineers, politicians, community
				Helps designers to make better, safer designs	Questions established practices							(Over what period do attitudes change?)
				Outside expert results in changes locals overlooked?	Christchurch type of safety audit (all jobs)-reviewed at 3 stages-peer review - feedback to designers-changes attitude by designers- promotes safety culture (by all involved)							
				Christchurch type of safety audit (all jobs)-reviewed at 3 stages-peer review - feedback to designers-changes attitude by designers- promotes safety culture (by all involved)	Feedback loop - spread to other organisations?							

TABLE 4 -TOPICS AND SUB-TOPICS

Potential methods of measuring or assessing V	Minimise the risk and severity of accidents at site or adjacent network	Minimise the need for remedial works after construction	Reduce the whole life costs of the project	Improve the awareness of safe design practices (including other professions!)	Increased skills in design and roadsafety engineering	Better management of schemes (design to operation)	Contributes to achieving road safety goals	Contributes to improved standards	Better facilities for vulnerable road users	Contributes to more efficient use of funds	Improves knowledge and data base for road safety	Better (designer) attitudes to road safety
Record particular **crashes** at a large number of sites and note changes over time. (LTSE crash records.)												
Look for "clustering" of crashes at sites in audited schemes												
Record particular **safety audit topics** at a large number of sites.note changes over time												
Do designers assess the benefit of makingchange? Discuss with them												
Proportion (and type) of recommendations adopted v. rejected by designers (or client- specify, survey												
Safety audit sites - which recommendations built?												
Safety audit sites - calculate reduced crashes due to SA change(s)												
Major problems - expert groups to assess (crash) savings?												
Changes in B/C (should be positive though more expensivel). Calculate - talk to designers.												
Counting defficiencies and trends in audited schemes. Longer term study of topics raised												
Random selection of designs to determine (a) audited (and benefits)and (b) not audited but would												
Health - qualitative evaluation - seek opinions on the process												
Change of attitude to safety audit within organisations - (survey, ask												
Vulnerable users (a) count features added or changed - study reports												
Vulnerable users (b) discuss with target group?												
Survey of designers - has S.A. helped (questionaire)												
Note changes in standards from SA												
Bias by selection - is it a problem - survey and quantify effects												
Feedback; does knowledge of SA spread to other organisations? survey												
Feedback - acceptances by designers being fed back to auditors-												
Feedback - actual changes implemented being recorded and fed back to appropriate people and central data bank - survey												

TABLE 5 -TOPICS AND METHODS OF MEASUREMENT
(darker shading indicates a strong relationship)

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REVIEW OF LITERATURE DESCRIBING BENEFITS OF SAFETY AUDIT

APPLE3/LITREV.DOC

• 1. *Austroads Road Safety Audit Project - Report 2, October 1992*

This is essentially a briefing report rather than an assessment of actual benefits. Presumably we might hear more from Austroads or Vicroads when the project RS3 B3 is pursued further. The following list is very compressive and includes benefits not listed to date

1. Safer new highways through accident prevention and accident severity reduction.
2. Safer road networks
3. Enhancement of road safety engineering
4. Reduced whole life costs of schemes
5. A component of a casualty reduction target (local or national)
6. Reduced need to modify new schemes
7. A national monitoring of road safety engineering
8. A better understanding and documentation of road safety engineering
9. Eventual improvements to standards and procedures
10. A better attitude to safety
11. Better consideration of vulnerable road users
12. A component of road safety plan (local or National)
13. A component of corporate safety strategy
14. Involvement of managers in road safety
15. Involvement of designers, contractors and maintenance staff in road safety.

- COMMENT

This list includes topics which seem to overlap or which are secondary to the main aim of saving accidents which might otherwise have happened. It seems that there are possibly two levels of benefit:- (1) those which can result in a reduction in accidents or, conversely, safer roads, and (2) those which result in better practice or support other desirable objectives.

I would like to add "on going training of safety staff and improvement of procedures"

• 2. *IHT Guidelines for the safety audit of highways*

Note "highways" not "designs for highways". A small but interesting point.

In essence this section states that there has been little experience of safety audit and the benefits cannot yet be quantified. There is, however, evidence documented of several major junction improvements where accident problems developed within the first and second years of operation. Some of these collisions could have been saved by the application of low cost measures which could have been identified at the time of designing the scheme or during construction. Secondly, other collisions "could not be influenced other than by major reconstruction of junctions and structures". These (designs) could have been changed at negligible cost at the planning and design stages. Potential benefits were assessed at 1/3 of (all) the accidents reported.

As an example, the author states that one accident saved per scheme L22,000 - 1988 prices -would have exceeded the cost of the safety audit, typically L900 for schemes up to L100,000. **The article does not actually claim the saving of one accident.** (see 4, below). The travelling public should be presented with a consistently safe product.

- **COMMENT**

It would be interesting to have actually documented examples. Presumably the schemes referred to in the above text were listed somewhere. Perhaps the IHT could fill in with a few documented examples - or could be persuaded to carry out an investigation into the claimed dis-benefits of not carrying out a safety audit.

- ***3 Road safety audit - Austroads.***

This document (contact Phil Jordan) simply lists two references which would be worth following up - SABEY 1993, and LOTHIAN REGIONAL COUNCIL, both of which are being followed up.

- ***4 An audit time, an audit place : World Highways.***

November/December 1994 Author Martin Heath, with Colin Buchanan and partners.

This article describes procedures and common problems, and goes on to describe the benefits, with a similar logic to the IHT GUIDELINES (see above). It suggests that each highway scheme audited will witness the saving of one accident at a cost saving of US$60,000 (compare with the UHT above). The author lists the typical costs of a safety audit of US$2,500. Compare this also with the UHT (L900)

- ***5. Road safety audit - the AUSTROADS project (P. Jordan)***

This general article in vol 3, No 1, Road and transport research, March 1994, gives the same two references: (a) Lothian Regional Council (1991) notes for in-house training course on safety audit - 12 June (1991) and (b) SABEY B.

E. (1993) Safety audit procedures in practice. Proceedings of Traffex '93, Birmingham UK April 1993.

• 6. *Report on trunk road safety audits for Scottish Office Industry Department.*

- **(a) Tayside Regional Council**

As well as describing actual audits, the document includes the following statement:

"Monitoring of schemes after opening and up to stage 4 checking is carried out by direct contact with Strathclyde Police. This allows any problems with operation of a new scheme to be quickly identified and tackled.

Of the 9 schemes which have been audited to date to stage 4 only 2 have identified an accident pattern which justified further investigation.

One of these was mainly weather related and changes to winter maintenance procedures have been proposed, the other involved a scheme which had only been audited at stage 4 and had an accident concentration at a priority junction. It is likely that had this scheme been audited at a stage 2 level then a right turn storage area would have been recommended.

The monitoring procedures in place at present would therefore appear to be adequate in identifying any accident patterns after opening."

- **COMMENT**

This is an attempt to quantify the benefits but the method is far from rigorous if significance were sought. The last paragraph does however, give confidence that monitoring will show up not only accident patterns, but also those which could have been avoided, had an appropriate safety audit been carried out. This gives some indication of a monitoring system for New Zealand, presumably using the LTSA accident data base

The report admits that 9 schemes does not provide an adequate data base and recommends that all UK data (of safety audited schemes and crash data) be used.

- **(b) Fyfe Regional Council**

Their r[port lists examples of audits at all stages, but particularly stages 2 and 3. Common problems are listed. The only trunk road improvement with a three year history had no clustering of accidents and only scattered accidents over a 10 km length of road. This is taken as evidence of successful safety auditing.

- **COMMENT**

The reference to clustering is interesting; if that (or the lack of it) were a measure of success then it should be possible to analyse several New

Zealand safety audited schemes when, say, three years has elapsed. If serious clustering were evident on two year old schemes then perhaps the data can be accepted ass evidence of failure to identify a problem. Presumably, if a problem can be identified which could have been fixed, then the amount of data could be a secondary consideration. Also, if schemes which have not been safety audited show similar clustering at sites which could have been identified and corrected, then this too is evidence in support of safety audit.

- (c) **Borders Regional Council** states that it is too early to quantify benefits, if any.
-
- (d) **Lothian Regional Council** expresses concern over the definition of responsibility for safety audits, independence of auditors, and the difficulty in accepting "impractical or expensive changes.
-
- COMMENT

  It looks as if Lothian has had some nasty experiences. This prompts the thought that in trying to quantify benefits, we should not overlook dis-benfits, including the reluctance of the client or designer to accept changes which are, in their opinion, impractical or too expensive. This needs to be set against the potential savings in (and value of) avoidable accidents

- (e) **Dumfries and Galloway Regional Council** express concern at thew lack of detail in drawings and non compliance with standards (or the lack of them)

- COMMENT.

  This seems to highlight another area of potential benefit in improving designs and standards.

- **(f). Grampian Regional Council** simply comments favourably.

- **(g). Central Regional Council**

  states that there isn't enough early safety auditing. Designers need to know more about drivers and their capabilities. Drivers expectations should not be raised when inconsistencies may lie ahead (waiting to ensnare? MLG). It seems that the Council had some nasty experiences with schemes which resulted in increases in collisions on adjacent roads or junctions, in particular a roundabout with an apparent doubling in collisions.

COMMENT

The point is well made that effects on the existing network, or the transition area to existing layouts, need to be watched and possibly safety audited at the same time as the scheme being dealt with.

- ***7. Effectiveness of road safety audit: IHT Technical Committee 4S-7, February 1995***

This report quotes GOODGE as saying 1/3 of crashes can be saved by safety audit, costs of safety audits in the UK of L2000 - L3000 per stage (1993)for small jobs and twice that for larger jobs. Typical crash values are L20,000 (1991) Lothian is quoted as saying 1/3 can be saved, Transit New Zealand is quoted as suggesting a B/C ratio of 20:1 for safety audit processes. (why don't we then do them all? MLG)

References of value include GOODGE M (1992) Benefits and costs of road safety audit - Austroads, JORDAN PW (1994) The Austroads approach. Road Transport and Research (ARRB), Lothian Regional Council (1991) notes of in-house tramming course on road safety, SABEY BE (1993) Safety audit procedures and practice Traffex '93 (PTRC), TRANSIT NEW ZEALAND (1993) Road safety audit: proposed implementation of policy (submission 93/7/1292) (TNZ)

- ***8. Road safety audits: RTA New South Wales***

"Costs and benefits". Costs range from $A1,000 per stage for a small scheme and $A8,000 per stage for a large scheme. An example suggests a safety audit cost of $2,000, a correction costing $3,000, the redesign saves 11 right angled collision/year over the (assumed) 10 year life span of the scheme. The benefit would be $299,000 and the BC ratio 60:1

- **COMMENT.**

A compelling argument if it is true. However, in my opinion, even if the values were as stated, it would be necessary to carry out a BC exercise including other matters and issues as well eg time penalties, effects on adjacent network. Interesting, though.

- ***9. Internal memo: Alan Dixon to "GMSS,STEDMRTS (Ak, Wn, Ch)***

This quotes Mike Goodge's paper for the "Austroads Safety Audit Project: benefits and costs of road safety audit. Taking Barbara Sabey's estimate of 5% this would translate to 608 accidents or $141,600,000 in NZ terms. Alan Dixon discusses the costs of audits and proposes the following example:

Assuming a maximum number of safety audits per year of 1000;

Then if 1000 = 5% Accident reduction.
In first year say 200 schemes = 1% Accident reduction
In 1991 there were 12,162 Injury Accidents (reported? MLG)
1% represents 120 injury accidents
If we take an average cost of 236,000/Accident
1% reduction = $28,320,00(0)

Using D. Tp estimate of 10 man/days per scheme

costs/hr $100
Cost = $7,000/Audit

Cost: 200 scheme = $1,400,00(0)

$$B/C = \frac{28,320,000 = 20.2}{1,400,000}$$

B/C = 20

The author goes on: "This happens to be the B/C that we are currently quoting for low Cost Accident Remedial Schemes" Alan Dixon gives his opinion that the B/C of 20:1 is in the right area"

- **COMMENT**

Probably the best that can be expected at the time, to improve on this will require more data, and more reliable data. I wonder if the reporting rate should be used as a factor, unless it is built into the costs per accident.

- ***10. Practicing safety audit - S. Proctor (Highway safety by design, 1991)***

The author says it is not easy to quantify benefits but (once again!) quotes the saving of one accident per year valued at L23,730.

- ***11 Road safety audit: progress in New Zealand and Australia : Appleton and Jordan***

Under "Effectiveness of safety audit" the authors describe the difficulty of estimating something you have avoided, but quote the cost of one audit as being about $5,000NZ and refers to "several authorities" coming up with Bcs of between 15:1 and 20:1]

- ***12 What is road safety audit and why do we need it?: P Jordan***

User "Benefits achieved" the author quotes Lothian - the prevention of 1/3 of accidents through the use of safety audit **and** that a 1% accident saving worth L1,000,000 per year is possible across the country (UK?) at a resource cost of just $70,000.

Once again he refers to the Lothian in-house training session.

- ***13. Safety audit procedures and practice B E Sabey; Traffex '93, Birmingham UK***

Like most other authors, Sabey refers to the difficulty of estimating or predicting benefits, but - interestingly - refers to "case studies" of highway schemes which displayed danger spots which could have been avoided by the use of safety audit. She refers to:

High speed approaches
poor skidding resistance
poor visibility
weaving problems
reduced sightlines

"An estimated 1/3 of accidents occurring at "black spots" which had developed could have been prevented. (Barbara states these matters quite definitely - I wonder if she could produce documentation? We may receive some but should ask, unless she is also quoting in the circular manner which seems prevalent. (I wonder about the poor skidding resistance)

SILCOCK is referred to - Engineering safer roads. PACTS Conference "Reducing traffic injury on target for 2000?"

- ***14. K. Ogden (professor) Road safety audit : prevention is better than cure***

(Civil engineering working paper, Dept of civil engineering, Monash University, May 1993)

The professor argues that a formal requirement for safety audit to be carried out will very likely lead to improved safety. (MLG: is there any way of comparing audit schemes with unaudited? Maybe the cluster test would help - about to be devised!!)

PROCTOR and BELCHER: British data: cost of audit L6,000 to 8,000, v. British crash costing some L20,000. The IHT suggests that one auditor is required to cover an area experiencing some 2000 crashes per year.

(COMMENT: Are these figures based on a calculation or actual data?

- ***15. The Surveyor magazine, 9 August 1990 - Article: "Safety audit for road schemes call".***

  This article quotes IHT speaker saying that for schemes less than L100,000, the cost of audit was L900, for larger schemes, L1500. An accident costs L22,600 (1988) and that "a change from time saving to accident saving could save "5% of the money road accidents cost the country each year"

  (COMMENT: I'm surprised at the reference to a change in emphasis, I would have thought that the COBA (UK B/C) would have placed equal or true value estimates of both, within the accuracy of costing.)

- ***16. Highways March 1990: Auditing safety by design. TMS Consultancy***

  This article refers to the cost of a UK accident of L22,260. It also refers to the COBA, TRRL and SAGAR reports. (what is sagar?)

  17 Road safety audit: the Australian approach; P Jordan (Routes/roads, No 288 September 1995

  The author quotes the list of benefits given in the first review of this report.

- ***17. Road safety audit : Proposed implementation of policy; Transit NZS submission No. 93/7/1292***

  Refers to the UK experience leading to B/C ratios of approximately 20.

  (COMMENT: This means, presumably, within the parameters acceptable in the standard B/C procedure. It may be useful to put a value of the intangibles. Not easy, but the whole question of estimating costs saved is very subjective. Perhaps this study will remove a little of that imprecision, or at least define the terms and expectations)

- ***18 Review of road safety audits. A. Crafer***

  This article in Highways and Transportation June 1995 describes the results of a questionnaire sent to Local Authorities and consultants. 100 were distributed, there were 60- replies. (not bad).

  The paper describes what is going on in safety audit (no real surprises) and states that "The evaluation of the effectiveness of safety audit is difficult. Future work may help to quantify the potential benefits of auditing schemes, possibly with the aid of validated accident prediction models"

- **COMMENT:**

  This is clearly one of the areas where progress is likely to be difficult, but to satisfy the modellers and holders of the purse strings, a validated model would be a godsend!

- ***19. Review of safety audit procedures and revision of the IHT Guidelines. Barbara Sabey, presentation to the Road Safety Auditors Forum, April 1995***

  Barbara Sabey lists the main findings of Angie Crafers study (these are of interest to compare to our own study - we should send copies to interested persons)

  The added cost of designs was about 0.5%

  She makes a similar statement to Ms Crafer about the need for studies to quantify benefits, without referring to a need for a model.

- ***20 Accident reduction on rural single carriageway whole routes; Highways agency Road safety auditors forum April 1995***

  This paper to that forum deals with whole route accident reductions - nothing new (though the topic is handled well). However, the author lists as a priority:

  "Prioritise using a computer model to predict the number of accidents on a route. The model was developed using traffic, accident and layout data from a sample of 35 routes. The larger the positive difference between the actual number of accidents and those predicted from the model, the more likely that a route has problems that justify investigation"

- **COMMENT:**

  If this model - or one like it - were produced for New Zealand roads, it would be one step further to predict the accident pattern or number on changed or completely new layouts. Such a procedure would be distasteful to many (like triage at an accident site) but to be honest, most roads carrying a reasonable traffic flow, particularly where layouts are a compromise between carrying through traffic and serving the access needs of property alongside, plus parking, cycle and pedestrian flows, are likely to retain an accident pattern. Where the problem is likely to lie is were the accident rate is too high, or there is a prevalence of one or more accident types, or there is clustering.

Final comments

These are all the references I have to hand. I will use the library to operate Internet. Is there anybody in Wellington that can have access to that? My computer will be replaced shortly. Maybe I should take advantage of offers of no interest for a year etc!

I think there have been useful leads revealed in this review. I look forward to the results of the round table.

Mike Gadd, March 1996